

## IEM's AI Modeling: Short-term COVID-19 Projections

Date: 4/27/21

Leveraging over 15 years of support to HHS for medical consequence modeling and our proprietary artificial intelligence (AI) models, IEM believes that our Coronavirus model outputs can be used to assist localities and their medical facilities to better prepare for an increase in hospitalizations, to better plan for and locate drive-through testing facilities, and to determine where increased levels of transmission may be occurring.

**We have been refining our AI model over the past month and are confident in its ability to provide accurate 7-day projections that can be used for operational and logistical planning.**

### AI-based Model Background

IEM is currently using an AI model to fit data from various sources and project new cases of COVID-19. We do not assume the average number of secondary infections (R-value) stays the same over time. IEM's AI model finds the best R-value over time to evaluate how it changes over the course of the outbreak. The IEM modeling team is running ~11 million simulations to fit each state's data and using the best fit for the R-value to project new cases over the next 7 days. The AI models are executed on a daily basis to evaluate the changing dynamics of the COVID-19 pandemic. Our projections have typically been within 10%, and are often within 5%, of actual confirmed cases.

The projections shown in this document are based on data pulled in as of 4/27/21 9 a.m.

**Please provide any feedback or send any questions that you might have to us. We are continually updating and improving the model, so your feedback is critical.**

**Also, if you have more current or refined data for your State, Commonwealth or Territory that you would like IEM to factor in, please let us know.**

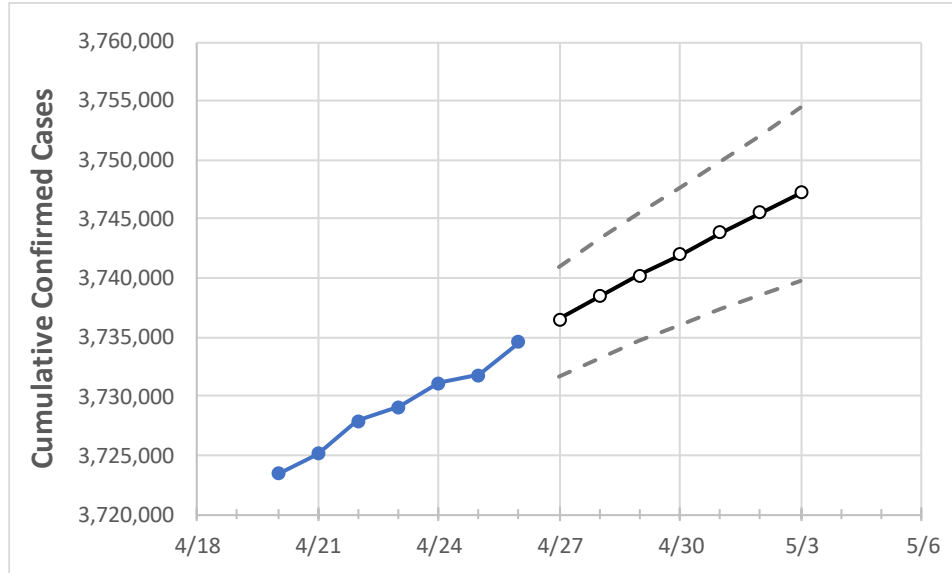
### IEM's Modeling Lead

Dr. Prasith "Sid" Baccam is a **Computational Epidemiologist expert** at IEM with more than **20 years of experience in medical consequence modeling and simulation of disease outbreaks** and medical consequences following hypothetical attacks with biological agents or emerging infectious diseases. He develops key simulation models and decision support tools at IEM, specializing in public health, disaster response, and medical countermeasures (MCM) to enhance data-driven decision making and improve modeling assumptions.

Upon receiving his **Ph.D. in Applied Mathematics and Immunobiology** at Iowa State University, Dr. Baccam worked as a Postdoctoral Research Associate at Los Alamos National Laboratory where he focused on researching viral and immunological modeling. After his stint at Los Alamos, Dr. Baccam has served as Task Lead in multiple public health projects have allowed him to develop expertise as a mathematical biologist and a leader on high-performance modeling and simulation teams.

He has worked with state and local public health officials as well as Federal agencies, including **HHS**, the Centers for Disease Control and Prevention (**CDC**), and the Department of Homeland Security (**DHS**). Dr. Baccam has published numerous papers on public health response models and implications on policy and has been invited to participate in workshops and symposiums held by the Institute of Medicine (now the National Academy of Health). His modeling results have been briefed to the **Executive Office of the President** and informed two presidential policy actions.

California State Projections



	Actual Confirmed Cases On:				Projected Cases For:						
	4/23	4/24	4/25	4/26	4/27	4/28	4/29	4/30	5/1	5/2	5/3

California 3,729,116 3,731,145 3,731,770 3,734,562 3,736,493 3,738,413 3,740,223 3,742,009 3,743,820 3,745,537 3,747,247

*Note: The State's projection shows a "best estimate" curve (the solid line with circles) and the dotted lines are the upper and lower estimates around that best estimate. Our projections have typically been within 10%, and are often within 5%, of actual confirmed cases.*

California Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	4/23	4/24	4/25	4/26	4/27	4/28	4/29	4/30	5/1	5/2	5/3
Alameda	85,829	85,935	86,016	86,162	86,269	86,376	86,485	86,593	86,702	86,811	86,923
Contra Costa	67,396	67,492	67,587	67,670	67,757	67,843	67,930	68,018	68,106	68,194	68,281
Fresno	100,864	100,928	100,991	101,061	101,109	101,156	101,201	101,246	101,289	101,332	101,375
Kern	108,195	108,256	108,280	108,313	108,372	108,431	108,487	108,545	108,602	108,660	108,716
Lake	3,423	3,425	3,426	3,427	3,430	3,432	3,435	3,438	3,440	3,443	3,445
Los Angeles	1,230,792	1,231,186	1,231,532	1,231,838	1,232,189	1,232,526	1,232,860	1,233,186	1,233,509	1,233,828	1,234,133
Marin	13,893	13,902	13,908	13,913	13,919	13,924	13,930	13,936	13,941	13,946	13,952
Monterey	43,360	43,374	43,374	43,374	43,389	43,403	43,418	43,433	43,448	43,463	43,478
Orange	269,433	269,549	269,633	269,724	269,811	269,898	269,982	270,066	270,146	270,224	270,302
Placer	22,028	22,054	22,081	22,107	22,141	22,176	22,211	22,244	22,277	22,310	22,341
Riverside	297,881	297,921	297,961	298,001	298,081	298,159	298,232	298,307	298,377	298,447	298,515
Sacramento	102,071	102,125	102,179	102,486	102,633	102,777	102,926	103,075	103,225	103,376	103,532
San Bernardino	295,390	295,452	295,510	295,565	295,675	295,784	295,891	295,997	296,100	296,199	296,301
San Diego	275,913	275,916	275,411	275,540	275,705	275,870	276,032	276,185	276,340	276,491	276,636
San Francisco	36,218	36,252	36,285	36,310	36,345	36,381	36,416	36,450	36,485	36,520	36,555
San Joaquin	71,936	71,972	71,980	71,987	72,043	72,099	72,154	72,208	72,262	72,315	72,369
San Luis Obispo	21,055	21,071	21,101	21,130	21,154	21,178	21,202	21,227	21,251	21,274	21,298
San Mateo	41,345	41,386	41,424	41,465	41,505	41,545	41,585	41,623	41,663	41,703	41,744
Santa Barbara	33,994	34,035	34,054	34,073	34,095	34,118	34,139	34,160	34,181	34,202	34,223
Santa Clara	117,678	117,755	117,860	117,965	118,081	118,194	118,308	118,423	118,535	118,648	118,762
Santa Cruz	15,831	15,836	15,840	15,899	15,938	15,977	16,018	16,062	16,108	16,153	16,201
Solano	32,173	32,220	32,266	32,313	32,359	32,406	32,452	32,499	32,547	32,595	32,645
Sonoma	29,755	29,762	29,778	29,794	29,807	29,819	29,830	29,842	29,852	29,862	29,871
Ventura	80,430	80,454	80,478	80,502	80,530	80,557	80,584	80,611	80,638	80,664	80,690

Some recipients of our daily COVID-19 short-term (7 day) projections have requested projections of demand for: hospital bed, intensive care unit (ICU) beds, and mechanical ventilation. We realize that different states and localities will have different characteristics for hospital demand of COVID-19 cases, and we are presenting the best assumptions we could find for those medical demands based on scientific literature and health data reporting. Specifically:

- **Beds:** For hospitalization, we use a range of 10% and 20% of cases require hospitalization based on CDC's report ([MMWR, March 18, 2020](#)) and state reports of COVID-19 cases.
- **ICU:** The CDC report found that 24% of hospitalized cases require ICU care.
- **Ventilators:** Based on clinical data from China and state reports, we assume that 50% of ICU cases require a ventilator.

If you have other estimates for these assumptions, please share them with us as we work to refine our modeling, assumptions, and data on a daily basis.

The medical demands shown in the table assume 20% of **cumulative** confirmed cases require hospitalization. To get the medical demand for the assumption that 10% of confirmed cases require hospitalization, simply divide the demand by 2.

### California Medical Demand by County

	Actual Confirmed Cases On:				Projected Cases (Hospitalized) [ICU] {Ventilator} For:											
	4/23	4/24	4/25	4/26	4/28				4/30				5/2			
Alameda	85,829	85,935	86,016	86,162	86,376	(17,275)	[4,146]	{2,073}	86,593	(17,319)	[4,156]	{2,078}	86,811	(17,362)	[4,167]	{2,083}
Contra Costa	67,396	67,492	67,587	67,670	67,843	(13,569)	[3,256]	{1,628}	68,018	(13,604)	[3,265]	{1,632}	68,194	(13,639)	[3,273]	{1,637}
Fresno	100,864	100,928	100,991	101,061	101,156	(20,231)	[4,856]	{2,428}	101,246	(20,249)	[4,860]	{2,430}	101,332	(20,266)	[4,864]	{2,432}
Kern	108,195	108,256	108,280	108,313	108,431	(21,686)	[5,205]	{2,602}	108,545	(21,709)	[5,210]	{2,605}	108,660	(21,732)	[5,216]	{2,608}
Lake	3,423	3,425	3,426	3,427	3,432	(686)	[165]	{82}	3,438	(688)	[165]	{83}	3,443	(689)	[165]	{83}
Los Angeles	1,230,792	1,231,186	1,231,532	1,231,838	1,232,526	(246,505)	[59,161]	{29,581}	1,233,186	(246,637)	[59,193]	{29,596}	1,233,828	(246,766)	[59,224]	{29,612}
Marin	13,893	13,902	13,908	13,913	13,924	(2,785)	[668]	{334}	13,936	(2,787)	[669]	{334}	13,946	(2,789)	[669]	{335}
Monterey	43,360	43,374	43,374	43,374	43,403	(8,681)	[2,083]	{1,042}	43,433	(8,687)	[2,085]	{1,042}	43,463	(8,693)	[2,086]	{1,043}
Orange	269,433	269,549	269,633	269,724	269,898	(53,980)	[12,955]	{6,478}	270,066	(54,013)	[12,963]	{6,482}	270,224	(54,045)	[12,971]	{6,485}
Placer	22,028	22,054	22,081	22,107	22,176	(4,435)	[1,064]	{532}	22,244	(4,449)	[1,068]	{534}	22,310	(4,462)	[1,071]	{535}
Riverside	297,881	297,921	297,961	298,001	298,159	(59,632)	[14,312]	{7,156}	298,307	(59,661)	[14,319]	{7,159}	298,447	(59,689)	[14,325]	{7,163}
Sacramento	102,071	102,125	102,179	102,486	102,777	(20,555)	[4,933]	{2,467}	103,075	(20,615)	[4,948]	{2,474}	103,376	(20,675)	[4,962]	{2,481}
San Bernardino	295,390	295,452	295,510	295,565	295,784	(59,157)	[14,198]	{7,099}	295,997	(59,199)	[14,208]	{7,104}	296,199	(59,240)	[14,218]	{7,109}
San Diego	275,913	275,916	275,411	275,540	275,870	(55,174)	[13,242]	{6,621}	276,185	(55,237)	[13,257]	{6,628}	276,491	(55,298)	[13,272]	{6,636}
San Francisco	36,218	36,252	36,285	36,310	36,381	(7,276)	[1,746]	{873}	36,450	(7,290)	[1,750]	{875}	36,520	(7,304)	[1,753]	{876}
San Joaquin	71,936	71,972	71,980	71,987	72,099	(14,420)	[3,461]	{1,730}	72,208	(14,442)	[3,466]	{1,733}	72,315	(14,463)	[3,471]	{1,736}
San Luis Obispo	21,055	21,071	21,101	21,130	21,178	(4,236)	[1,017]	{508}	21,227	(4,245)	[1,019]	{509}	21,274	(4,255)	[1,021]	{511}
San Mateo	41,345	41,386	41,424	41,465	41,545	(8,309)	[1,994]	{997}	41,623	(8,325)	[1,998]	{999}	41,703	(8,341)	[2,002]	{1,001}
Santa Barbara	33,994	34,035	34,054	34,073	34,118	(6,824)	[1,638]	{819}	34,160	(6,832)	[1,640]	{820}	34,202	(6,840)	[1,642]	{821}
Santa Clara	117,678	117,755	117,860	117,965	118,194	(23,639)	[5,673]	{2,837}	118,423	(23,685)	[5,684]	{2,842}	118,648	(23,730)	[5,695]	{2,848}
Santa Cruz	15,831	15,836	15,840	15,899	15,977	(3,195)	[767]	{383}	16,062	(3,212)	[771]	{385}	16,153	(3,231)	[775]	{388}
Solano	32,173	32,220	32,266	32,313	32,406	(6,481)	[1,555]	{778}	32,499	(6,500)	[1,560]	{780}	32,595	(6,519)	[1,565]	{782}
Sonoma	29,755	29,762	29,778	29,794	29,819	(5,964)	[1,431]	{716}	29,842	(5,968)	[1,432]	{716}	29,862	(5,972)	[1,433]	{717}
Ventura	80,430	80,454	80,478	80,502	80,557	(16,111)	[3,867]	{1,933}	80,611	(16,122)	[3,869]	{1,935}	80,664	(16,133)	[3,872]	{1,936}

For additional information from IEM, please contact Bryan Koon, Vice President of Emergency Management and Homeland Security at [bryan.koon@iem.com](mailto:bryan.koon@iem.com) or 850-519-7966 or Stephanie Tennyson at [stephanie.tennyson@iem.com](mailto:stephanie.tennyson@iem.com) or 202-309-4257.